SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS

Idaho Operations Office – Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho LLC

INTEC 603 Basin Floor Scanning

The INTEC 603 spent fuel storage basins have been emptied of all identified fuel. As part of the next stage of decommissioning, the bottom of the fuel storage pools required a survey to determine that no spent nuclear fuel material remained. INEEL Spent Fuel Operations, in conjunction with the INEEL NDE Physics group developed a system using three shielded, collimated sodium iodide gamma ray spectrum assay heads that were used to survey the basin floor. The detector heads are able to distinguish spent nuclear fuel material from the high background radiation present in the silt that remains on the basin floor. The three storage basins, loading pits and transfer channel were surveyed. The basin floor scanning system also utilized position location instrumentation to allow detailed mapping of the area survey and the results of the surveys for future decommissioning efforts.

Benefit: Large area scanning allows reduced radiation exposure to operators. Automated data acquisition allows pinpoint location of suspect fuel areas for future recovery activities. The safety of the basin sludge removal operations is dependent on being sure that no fuel material is present prior to basin decontamination.

Qualitative Benefit Analysis		
Programmatic Risk	●	Completion of decommissioning of the fuel storage basins eliminates environmental risks. This tool provides information for appropriate management.
Technical Adequacy	●	Gamma spectrometry as used here allowed discrimination between fuel material and secondary fission product gamma ray background.
Safety	●	It is necessary to perform characterization of the basins to avoid criticality and undue personnel exposure during sludge removal.
Schedule Impact	●	Without this technology, the project of basin decommissioning would not have been able to proceed.

●	◒	○	◓	◉
Major improvement	Some improvement	No change	Somewhat worse	Major Decline

Quantitative Benefit Analysis	
Cost Impact Analysis	This is enabling technology that allowed resolution of material management concerns. It does not replace a prior alternative, and as such does not represent a comparative cost savings.

ESTIMATE BASIS FOR: **INTEC 603 Basin Floor Scanning**

GENERAL

INEEL Spent Fuel Operations, in conjunction with the INEEL NDE Physics group developed three head sodium iodide gamma ray spectrum assay system that surveys a nominal three foot wide area. It can be reconfigured in as many as seventeen different configurations to allow survey access to restricted areas and confined spaces in the basins. It includes a position verification system that provides arc-second measurement of head location to record head position for future hot spot remediation. Also included is an ultrasonic depth measurement system to ensure consistent source-to-detector distance control. The system can distinguish fuel material from the high background radiation present in the silt that remains on the basin floor. It was designed to identify any item containing as little as 0.5 gram of uranium-235 in an area of approximately 1 square foot at a height of one foot from the basin floor. Head orientation includes an overlap to ensure that the entire floor area was surveyed. The sodium iodide detectors were custom made for this project by Canberra. All mounting, collimation and shielding hardware was designed and fabricated by INEEL NDE Physics and Prototype Engineering departments, and the data acquisition system was developed and adapted for this purpose by INEEL Physics personnel.

INITIAL CAPITAL INVESTMENT

The primary costs of design, procurement and fabrication amounted to approximately $1,200,000.

INSTALLATION AND START-UP

Installation and startup costs amounted to approximately $200,000. These costs included significant procedure and training time as well as calibration and functional testing efforts. Readiness review costs are incorporated into this value as well.

ESTIMATE BASIS FOR: **INTEC 603 Basin Floor Scanning**

TRADITIONAL (BASELINE) TECHNOLOGY/METHOD

No baseline technology was identified for this issue. No large area survey technology was available to cover all of the large areas and confined spaces found in the fuel storage basins, thus a specialized technology was developed.

NEW TECHNOLOGY/METHOD

INEEL Spent Fuel Operations, in conjunction with the INEEL NDE Physics group developed a three headed sodium iodide gamma ray spectrum assay system that surveys a nominal three foot wide area. It can be reconfigured in as many as seventeen different configurations to allow survey access to restricted areas and confined spaces in the basins. It includes a position verification system that provides arc-second measurement of head location to record head position for future hot spot remediation. Also included is an ultrasonic depth measurement system to ensure consistent source-to-detector distance control. The system can distinguish fuel material from the high background radiation present in the silt that remains on the basin floor. It was designed to identify any item containing as little as 0.5 gram of uranium-235 in an area of approximately 1 square foot at a height of one foot from the basin floor. Head orientation includes an overlap to ensure that the entire floor area was surveyed. This determination is based on quantitation of cesium-137 and comparison of that value against a baseline fuel material of specific enrichment and burnup. The sodium iodide detectors were custom made for this project by Canberra. Alternate cadmium zinc telluride detectors can be used as necessary in areas of high radiation background. All mounting, collimation and shielding hardware was designed and fabricated by INEEL Physics and Prototype Engineering departments, and the data acquisition system was developed and adapted for this purpose by INEEL Physics personnel.

COST SAVINGS/COST AVOIDANCE/RISK REDUCTION

This is an enabling technology, and as such, no direct cost savings is calculated. Decommissioning of this facility with the potential of unidentified fissile material remaining could not be done.

ESTIMATE BASIS FOR: **INTEC 603 Basin Floor Scanning**

Worksheet 1: Operating & Maintenance Annual Recurring Costs

Expense Cost Items *	Before (B) Annual Costs	After (A) Annual Costs
1. Equipment	$ -	$ -
2. Purchased Raw Materials and Supplies	$ -	$ -
3. Process Operation Costs:		
Utility Costs	$ -	$ -
Labor Costs	$ -	$ -
Routine Maintenance Costs for Processes	$ -	$ -
Subtotal	$ -	$ -
4. PPE and Related Health/Safety/Supply Costs	$ -	$ -
5. Waste Management Costs:		
Waste Container Costs	$ -	$ -
Treatment/Storage/Disposal Costs	$ -	$ -
Inspection/Compliance Costs	$ -	$ -
Subtotal	$ -	$ -
6. Recycling Costs		
Material Collection/Separation/Preparation Costs:		
a) Material and Supply Costs	$ -	$ -
b) Operations and Maintenance Labor Costs	$ -	$ -
Vendor Costs for Recycling	$ -	$ -
Subtotal	$ -	$ -
7. Administrative/other Costs	$ -	$ -
Total Annual Cost:	$ -	$ -

* See attached Supporting Data and Calculations.

ESTIMATE BASIS FOR: **INTEC 603 Basin Floor Scanning**

Worksheet 2: Itemized Project Funding Requirements*
(i.e., One Time Implementation Costs)

Category	Cost $
INITIAL CAPITAL INVESTMENT	
1. Design	$ 625,000
2. Purchase	$ 150,000
3. Installation	$ -
4. Other Capital Investment (explain)	$ 425,000
Subtotal: Capital Investment= (C)	$ 1,200,000
INSTALLATION OPERATING EXPENSES	
1. Planning/Procedure Development	$ 30,000
2. Training	$ 40,000
3. Miscellaneous Supplies	$ -
4. Startup/testing	$ 130,000
5. Readiness Reviews/Management Assessment/Administrative Costs	$ -
6. Other Installation Operating Expenses (explain)	$ -
Subtotal: Installation Operating Expense = (E)	$ 200,000
7. All company adders (G & A/PHMC Fee, MPR, GFS, Overhead, taxes, etc.)(if not contained in above items)	$ -
Total Project Funding Requirements=(C + E)	$ 1,400,000
Useful Project Life = (L) 1 Years Time to Implem 24 Months	
Estimated Project Termination/Disassembly Cost (if applicable) = (D) (Only for Projects where L<5 years; D=0 if L>5 years)	$ -

TOTAL LIFE-CYCLE COST SAVINGS CALCULATION FOR IPABS-IS

(Before - After) x (Useful Life) - (Total Project Funding Requirements + Termination)

Total Life Cycle Cost Savings Estimate = (B - A) x L - (C+E+D)

RETURN ON INVESTMENT CALCULATION

Return on Investment (ROI) % =

$$\frac{\textit{(Before - After) - [(Total Project Funding Requirements + Termination)/Useful Life]}}{\textit{[Total Project Funding Requirements + Project Termination]}} \times 100$$

$$\text{ROI} = \frac{(B-A)-[(C+E+D)/L}{(C+E+D)} \times 100 \quad -100 \ \%$$

O&M Annual Recurring Costs:				Project Funding Requirements:			
Annual Costs, Before=	$	-	(B)	Capital Investment=	$	1,200,000	(C)
Annual Costs, After=	$	-	(A)	Installation Op. Exp=	$	200,000	(E)
Net Annual Savings=	$	-	(B-A)	Total Project Funds=	$	1,400,000	(C+E)

Note: Before (B) and After (A) are Operating & Maintenance Annual Recurring Costs from Worksheet 1.

* See attached Supporting Data and Calculations.

SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS
DEPLOYMENT APPROVALS

Technology Deployed: INTEC 603 Basin Floor Scanning

Date Deployed: September 2001

EM Program(s) Impacted: Spent Nuclear Fuel Program

Approval Signatures

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Contractor Program Manager Date

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Contractor Program Manager Date

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DOE-ID Program Manager Date

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DOE-ID Program Manager Date